WIND POWER SOLUTIONS

Hydro
Wind
Geothermal
Solar
Tidal
Biomass
Nuclear
Coal
Gas
Oil
Air Quality Control Systems
Power Automation and Controls
Lifecycle Management
CO2 Solutions
Welcome to Alstom Power

Alstom is a global leader in power generation with a portfolio of products covering all fuel types. From fossil and biomass to nuclear and renewables, close to 25% of the world’s power production capacity depends on Alstom technology or services.

Whether in design, manufacture, procurement or servicing, Alstom is setting the benchmark for innovative technologies that provide clean, efficient, flexible and integrated power solutions. Alstom can supply anything from single components to complete turnkey power plants. Our Plant Integrator™ approach and power automation and control solutions ensure the optimisation of all elements to derive the maximum lifetime value from all our customer’s investments.

Alstom has more than 100 years of experience in engineering, procurement and construction (EPC) of new power plants. But our engineers are also experts in retrofitting, modernising and servicing existing plants. With operations in 70 countries, Alstom is close to customers all over the world, ensuring rapid responses and service excellence at all times.

Provider of the cleanest integrated power
Power as **endless** and **pure** as the sky

The **Alstom advantages**  We deliver, we lead, we care............................................................... page 04
An impressive track record and portfolio of proven products. A global footprint.

**From turbines to turnkey solutions**  Your needs, our solutions................................. page 08
From site development, through manufacturing and assembly, to commissioning, operation and maintenance (O&M), Alstom optimises every development stage.

**Proven technology**  Protecting performance by design.............................................. page 10
Efficiency and reliability derived from superior and proven designs. Product features that increase yield, flexibility, smooth maintenance and adapt to changing wind and grid conditions.

**Optimising lifetime output**  From spare parts to operation and maintenance............. page 12
Integrated control and monitoring. Consulting and support. Lifecycle management.

**References**  30 years of designing proven wind turbines.............................................. page 14
Development of wind onshore and offshore technology.

Access to reliable and affordable power is the key to an improved standard of living for everyone. However, it is essential that this power be produced without negative environmental side effects. Alstom’s Plant Integrator™ solutions maximise performance, while our extensive range of environmental products enable us to supply the cleanest power plants in the industry.

Alstom’s Clean Power Today™ strategy recognises the need to improve the environmental balance of legacy plants, while increasing the adoption of new clean energy solutions. Its three pillars are:

1. **Focus on production efficiency and energy management**
2. **Implementation of carbon capture and storage**
3. **Balancing the energy portfolio by increasing the share of renewable technologies.**
Wind power plays a central role in Alstom’s clean power strategy because it is an inexhaustible, renewable resource that has come of age. After 30 years of development, Alstom wind turbines are reaching new heights of efficiency and reliability. Wind power projects also have excellent safety records and stimulate development through the creation of jobs and the promotion of local manufacturing capacities.

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PLANT INTEGRATOR™

Alstom’s Plant Integrator™ approach optimises performance by balancing the interactions between complex subsystems in a power plant. For Alstom’s wind offering, this is implemented primarily at the design and planning stages. Each generation of our wind turbines has extended the boundaries of what is conceivable making modern wind farm construction simpler and more efficient than ever.

LIFECYCLE MANAGEMENT

During operation, wind turbines produce an endless supply of fossil-free power. So Alstom’s top priority is to maximise the turbine lifetime yield. We also examine the entire product lifecycle to further improve wind’s positive environmental balance and increase the owner’s return on investment. Alstom also offers comprehensive services and long-term agreements to help new and established customers develop their wind portfolios.
Alstom delivers higher yields in wind energy thanks to our market-leading technologies. **Building on more than 30 years of designing and implementing proven and reliable wind power solutions**, we offer everything from turbines to turnkey wind farms, enhanced by years of operations and management experience, complemented with a state-of-the-art control and monitoring system.

**We deliver** Alstom offers a range of new generation wind turbine products that represent the culmination of 30 years of development and innovation: our platform of wind turbines was launched long before wind was considered a viable energy source. Since then, more than 2,100 turbines have been installed or are under construction in more than 100 wind farms delivering more than 2,700 MW.

**We lead** The heart of a wind farm is the turbine. A taller tower can reach better winds and larger rotors capture more energy. But weight and rigidity soon become limiting factors. In the search for optimised performance, Alstom’s wind turbines offer a host of cutting edge design features that increase power output. And by maintaining productivity in lighter breezes and stability in stronger gales, we lead the market in measured availability.

**We care** By choosing Alstom as your provider you can enjoy a partnership with one of the most trusted names in power generation. Unaffected by the winds of change, Alstom backs its promises with ongoing support and services, which give owners long-term investment and performance security.

**Wherever the wind blows**

The global headquarters of the Alstom wind business has been located in Barcelona, Spain since 1981. This is the centre for product design and innovation, engineering and project management. Manufacturing and assembly of the wind towers and turbines is spread across specialist production sites in Europe, and North and South America.

The Alstom wind business is supported by our global sales organisation giving us a global reach and the ability to serve customers wherever the wind blows.
Alstom offers a complete portfolio of power generation equipment and services for all fuel types. By 2030 the world will have seen a significant change in the power generation mix with an increased share of CO2-free and renewable power. Alstom has a strong role to play in the emerging and booming wind power market.
How do you find and secure the ideal location for a wind farm? Wind speed, terrain and grid access are all constraining factors. Although wind is green and clean, projects still need to gain the approval and acceptance of various stakeholders. Having developed wind farms for more than 30 years, Alstom has in-house capabilities to assess the project and support our customers in every stage of their project optimisation.

We procure opportunities for your project with the following services:

- Site localisation
- Wind measurement and validated simulations
- Environmental impact assessment
- Land lease agreements and permitting

With the ECO 80 and ECO 100 platform ranges, Alstom offers turbines suitable for most wind classes. Additionally, climate kits allow operation in deserts or very cold environments. With a design optimised for simple assembly, erection in complex terrains is even easier. Whatever your location, reliability matters most, so Alstom turbines come with the unique ALSTOM PURE TORQUE™ design and a flexible monitoring and control system. Many other design details contribute to low noise, safe operations and convenient maintenance.

We engineer reliable solutions and offer:

- ALSTOM PURE TORQUE™ concept for drive train reliability
- Best-in-class components and materials
- Manufacturing and module assembly
- Intelligent, remote monitoring and control systems

Our engineering team assesses your wind data to help you choose the turbine model best suited for your specific site conditions.

AN INTEGRATED APPROACH
Wind farm construction

Alstom has commissioned wind farms in Spain, UK, France, Italy, Portugal, Morocco, Brazil, USA, Turkey, Japan and India. No matter how remote the location or complex the terrain, we can prepare the site and organise the grid connections. Then we deliver the parts and assemble the towers and turbines. Alstom’s commitment is to go wherever our customers see their opportunity. That is why Alstom is now opening new facilities in North and South America and expanding activities in other new markets.

Alstom’s wind farm installation teams offer:
- Civil engineering work
- Module transport and on-site assembly
- Electrical infrastructure
- Erection and commissioning

Operation and Maintenance

Alstom is not just a leading global original equipment manufacturer (OEM), we are also responsible for the operation and maintenance (O&M) of the majority of our installed wind fleet. As part of our clean power strategy we are committed to harnessing wind power more effectively through better products. But we also encourage wind adoption by simplifying the O&M requirements for owners.

We optimise performance and reduce management uncertainties through:
- Preventive and corrective maintenance
- Parts delivery and upgrade packs
- Integrated control and remote monitoring services
- Field service and O&M contracts

Integrating design features to deliver optimised full turnkey wind farm solutions

The Alstom ECO 110, currently our largest wind turbine with a 110 meter rotor diameter, has a swept area larger than an Airbus A380. It is a sizeable feat of engineering to say the least! Yet, Alstom has established the processes and systems to deliver such products consistently on budget and on time. Always bearing in mind the integrated end result, design and manufacture is strictly modular, allowing for easier testing, transportation and assembly.
Engineering innovations drive evolving efficiency

The evolution of Alstom’s wind turbines was marked by engineering innovations that allowed an increase in the size and power output. Electrical pitch and yaw systems now perfectly control the energy uptake. Deflection stresses are handled by the ALSTOM PURE TORQUE™ system. Modular manufacturing simplifies assembly and testing. Better utilisation of the nacelle space improves efficiency, safety and ergonomics.

The expertise and vision of our team of wind experts and the synergies between our different areas of high-technology power generation equipment allow us to consistently offer cutting-edge technology to our customers. As part of our research and development plan, a new offshore platform is under development to offer a 6MW turbine with direct-drive technology and ALSTOM PURE TORQUE™ design for higher reliability. The prototype phase has started and will run through 2011 and 2012, followed by a pre-series in 2013 and series production in 2014.

**Offshore Platform**

New 6MW generation
- Power: 6MW
- Technology: Direct drive, ALSTOM PURE TORQUE™
ALSTOM PURE TORQUE™

All Alstom’s wind turbines feature the ALSTOM PURE TORQUE™ concept, a unique mechanical design that protects the drive train from deflection loads to ensure higher reliability. The rotor is mounted on a fatigue-resistant cast iron hub that transmits the gravitational load and deflection stresses via two sets of bearings to the tower. Meanwhile, the drive shaft elastically mounted on the front of the hub transfers pure torque (green arrows below) to the drive train free of the stresses and strains (red arrows below) that can arise due to buffeting.

Coping with extremes

**Temperatures**
Because the best wind is often found in the harshest climates, Alstom offers two climate kits. The cold climate pack adds heaters to extend the operating temperatures from -10°C down to -30°C. The hot kit offers special lubrication and bearings to extend the upper permissible ambient temperatures from +40°C to +45°C.

**Wind conditions**
Electrical yaw and pitch controls rapidly adapt the rotor alignments to changing wind conditions in order to keep the nominal power supply to the grid constant. The turbine braking system is also based primarily on pitch control and each blade is equipped with an autonomous power supply to ensure the safe braking of the turbine even in the most extreme conditions.

**Grid conditions**
Alstom wind turbines and generators are designed for optimum grid compliance. Not only do they meet all grid codes, but they are also highly responsive to changing conditions. As such they offer benefits to grid operators. For example, when a line fault creates grid instability, the wind farm can inject stabilising reactive current into the grid to help the grid recover.

**Certification**
All Alstom wind turbines go through the certification process according to IEC-EN standards by international organizations recognised to issue IEC-WT01 Type certificates. These standards requirements include the inspection of the assembly, full-scale testing of the blades and load, as well as performance and load measurements. The wind turbine power curve, emitted noise and power quality are measured by independent testing laboratories.
A partnership for performance

When you choose Alstom as your OEM, EPC or O&M provider you are buying into a wealth of wind know-how and experience. Our wind turbine fleet provides an abundance of data from which benchmarks and best practices are developed that make a real difference to the long-term efficiency and profitability of a plant.

The long-term performance potential of a wind farm is only partially determined at the manufacturing and construction stages. The best design and construction will be of little benefit if the operation and maintenance (O&M) are not fully optimised. That is why Alstom operates a global network of local service centres and offers a full range of O&M contracts, packages and services.

Alstom Operation and Maintenance strategies aim to:
- Maximise availability
- Improve energy generation
- Optimise component and system lifetime

The keys to achieving these goals, lie in system and component optimisation, effective planned maintenance and suitable upgrades and retrofits. In accordance with our clean power strategy, we always consider profitability and commercial excellence in the wider context of environmental, health and safety (EHS) considerations.

Consulting and Support
We help customers maximise plant performance, availability and reliability by offering performance and lifetime assessments, training, monitoring and diagnostics. Advanced analysis of fleet-wide data allows us to help you reduce risks and optimise availability.

Parts
With Alstom, you’ll never be without the parts you need. Apart from off-the-shelf spares, we offer repairs and reconditioning as well as custom-made components.

Field Service
There is always an Alstom engineer close at hand. Supported by our global centre of wind competence in Barcelona, Spain, the local service network provides a rapid response capability to reduce outage time and increase performance.

O&M Contracts
We offer a portfolio of operations and maintenance contracts based on performance commitments and incentives. The flexible offering covers engineering, products and services over the plant’s full lifecycle and can be tuned to match your business objectives.
Integrated control and monitoring

Based on 30 years of turbine maintenance experience and the latest developments in industrial communications, Alstom’s Supervisory Control And Data Acquisition (SCADA) system lies at the heart of our enhanced operation and maintenance strategy. Alstom’s SCADA is a web-based tool, which provides remote access to wind turbine data such as generated power, rotor rpm, electrical data, temperature of main components, mechanical sensors status, wind conditions and wind turbine status. Besides turbine data, it integrates wind farm masts and substation equipment and is compatible with most monitoring and control systems encountered in the energy business.

The system allows remote monitoring and distributed control, thus owners can benefit fully from the support of Alstom wind farm experts. By using Alstom’s SCADA the performance of an individual wind turbine or the whole wind farm can be studied and optimised in real time.

Furthermore, the remotely collected data can be used to establish benchmarks and identify irregularities allowing timely intervention to avoid unplanned outages or secondary damage.
Today Alstom is an established international wind turbine manufacturer operating wind farms in Spain, UK, France, Italy, Portugal, Morocco, Brazil, Turkey, Japan and India. Alstom’s 2,100 turbines currently installed or under construction can generate more than 2,700 MW.